"Method of inserting a barrier liner into a closure"

Field of the Invention

The present invention relates to a method and apparatus for forming a closure having a disc or liner, such as a barrier disc. The closure formed thereby has particular application for sealing containers for gas-sensitive product, such as oxygen-sensitive products.

Background of the Invention

Many products, such as beer and other malt beverage products, dairy products and real juices, must be packaged in such way that oxygen cannot migrate into the package before the package is opened to permit consumption of its contents; otherwise, over the normal shelf life of the filled package oxygen will degrade the flavor of its contents. Heretofore, such products, when packaged in glass containers, or, more recently in plastic bottles, have been capped with a closure, such as an aluminium roll-on closure or a molded plastic closure, that is lined with an internal liner that functions both as a sealing liner and, to a lesser extent, an oxygen-barrier liner. US Patent 4721221 (Barriac), the disclosure of which is incorporated by reference herein, discloses a molded plastic closure with a sealing liner, this reference teaching a top seal only liner for non-pressurized beverage products and a top and side seal liner for pressurized beverage products. In either case, the liner must sealingly engage the rim of the associated container, either on its top or both on its top and side, to properly seal the filled and capped container.

In recent years, there has been a concerted effort to eliminate the need for inserting a sealing liner in a molded plastic closure to eliminate the expense relating thereto. To that end, self-sealing molded plastic closures have been developed, and US Patents 5638972 (Druitt) and 5836464 (Druitt), disclosure of each of which is also incorporated by reference herein, teach unlined, molded plastic closures of a general type that has proven to be quite successful in the packaging of carbonated soft drink products, which, though somewhat less sensitive to the migration of CO_2 out of the product, are not particularly sensitive to the migration of oxygen into the packaged product. However, such closures, as heretofore used in the packaging of carbonated soft drinks, are not sufficiently oxygen-impermeable to permit their use in the

packaging of beer and other malt beverage products, and other oxygen-sensitive products, when such products must undergo a normal shelf life between packaging and opening for consumption.

One example of a self-sealing closure that also has a barrier disc that underlies the top panel of the closure is described in United States Application No 20030057175 (Willingham and Druitt), the disclosure of which is also incorporated by reference herein.

A potential problem with the use of barrier discs in closures is the necessity of achieving highly reliable positioning of the disc within the closure, particularly, in a relatively high-speed closure manufacturing process. This problem is potentially compounded in situations where the barrier disc is to be placed in unlined closures having other moulded structures therein adapted to provide sealing of the container on application of the closure.

The present invention is directed to a method and apparatus for positioning a disc, such as a barrier disc, into a closure otherwise suitable for sealing a container, in particular, a container for a pressurised product.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

Summary of the Invention

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The present invention relates to a method and apparatus for positioning a disc, such as a barrier disc, in a closure. In particular, the invention relates to a method and

apparatus for positioning a disc in a self-sealing moulded plastic closure having a sealing fin arrangement for providing a seal when the closure is appropriately applied to a finish of a container.

According to a first aspect, the present application is directed to a first invention comprising a method of forming a closure for application to a container comprising the steps of:

(a) providing a closure having a top panel and a skirt depending from the top panel;

(b) providing a disc in a position ready for insertion within the closure; and

(c) pressing said disc relatively into said closure such that at least a portion of said disc is positioned at least adjacent the top panel.

In this aspect, the closure can further have an annular sealing fin extending inwardly and downwardly from an interior of the closure and being integrally formed with the top panel, the sealing fin being adapted to engage a rim of a container and be folded into a sealing arrangement with the rim and at least a side of the finish of the container when the closure is secured to the container. The method can also further comprise the following step:

(d) applying a fluid pressure to the disc such that the entire disc is forced into a position at least adjacent the top panel.

According to a second aspect, the present application is directed to a second invention comprising a method of forming a closure for application to a container comprising the steps of:

(a) providing a closure having a top panel, a skirt depending from the top panel, and an annular sealing fin extending inwardly and downwardly from an interior of the closure and being integrally formed with the top panel, the sealing fin being adapted to engage a rim of a container and be folded into a sealing arrangement with the rim and at least a side of the finish of the container when the closure is secured to the container;

(b) providing a disc in a position ready for insertion within the closure;

(c) pressing said disc relatively into said closure such that at least a portion of said disc is positioned at least adjacent the top panel; and

(d) applying a fluid pressure to the disc such that the entire disc is forced into a position at least adjacent the top panel.

In one embodiment of the above aspects, step (b) can comprise a step of cutting or punching a disc from a sheet or feedstock of disc material. The step of cutting or punching the disc can occur while the sheet or feedstock is positioned adjacent a closure. A cutter, such as an annular or circular cutter, is preferably used to form a circular disc for pressing into the closure. The step of pressing the disc relatively into said closure can be performed at least essentially concurrently with the cutting or punching step. In another embodiment, pre-cut discs can be utilised and positioned ready for insertion into the closure in step (c).

In a further embodiment of the above aspects, at least steps (b) and (c) are performed with the closure in an insertion station positioned beneath the sheet or feedstock of disc material, or the pre-cut disc, with the disc being moved relatively downwardly into the closure in the process. In another embodiment, the insertion station can be positioned above the sheet or feedstock of disc material, or the pre-cut disc, with the disc being moved relatively upwardly into the closure in the process. In a still further embodiment, the insertion station can be positioned beside the sheet or feedstock of disc material, or the pre-cut disc, with the disc being moved sidewardly into the closure in the process.

The step of pressing the disc into the closure in step (c) is preferably performed using a tool having a plunger. The plunger is preferably adapted to move, preferably relatively downwardly, in operation and has a disc abutment surface.

The plunger can be in the form of a cylindrical tube having an outer and an inner surface and an annular disc abutment surface, the inner surface defining a lumen. In one embodiment, a pin can extend through the lumen of the plunger and also has an outer surface and a disc abutment surface. The outer surface of the pin is preferably also cylindrical. In another embodiment, the lumen can act as a fluid flow passage as defined below.

Where the pin extends through the lumen, the construction of the tool is preferably such that fluid flow can occur through the tool between the outer surface of the pin and the inner surface of the plunger. In one embodiment, air flow can occur between these two surfaces. Where no pin is present, fluid flow can occur through the lumen of the plunger.

During step (c), fluid, preferably air, can preferably be drawn through the tool. Where the pin is present, fluid can be drawn between the pin and plunger so as to form a region of relatively low pressure between the disc and the disc abutment surface of the pin and/or plunger. Where no pin is present, fluid can be drawn through the lumen to form a region of relatively low pressure between the disc and the disc abutment surface. In one embodiment, air is drawn relatively upwardly through the tool. This region of lower pressure serves to hold the disc to the tool as it is pressed into the closure by the plunger.

Once at least a portion of the disc, for example a central portion, is positioned close to or adjacent the top panel within the closure, the fluid flow through the tool can stop. This can then be followed by a flow of air or other fluid being forced through the tool in an opposite direction to that hitherto. Where the air flow direction had been relatively upwardly, the air flow can now move through the tool relatively downwardly. This fluid flow is directed against the disc and preferably serves to force the disc fully into the closure and into abutment with the underside of the top panel. In particular, the fluid flow preferably serves to force the periphery of the disc past the sealing fin that is extending inwardly and downwardly into the closure. Where the pin is present in the plunger, the fluid flow can be between the pin and the plunger. Where no pin is present, the fluid flow can be through the lumen of the plunger.

Either after, during or prior to the provision of fluid flow to force the disc into the closure, the plunger, and the pin where present, can be withdrawn, the direction of withdrawal being again preferably relatively upwardly.

According to a third aspect, the present application is directed to a third invention comprising an apparatus for positioning a disc in a closure, wherein the closure has a top panel and a skirt depending from the top panel, the apparatus comprising:

(a) an insertion station for supporting a closure for at least a portion of the disc positioning process; and

(b) a tool movable relative to the insertion station to drive a disc into the closure, the tool comprising a plunger adapted to press said disc into said closure such that at least a portion of the disc is adjacent the top panel.

In this aspect, the closure can have an annular sealing fin extending inwardly and downwardly from an interior of the closure and being integrally formed with the top panel, the sealing fin being adapted to engage a rim of a container and be folded into a sealing arrangement with the rim and at least a side of the finish of the container when the closure is secured to the container. When used with such a closure, the apparatus can further have a fluid flow passage through which fluid travels to apply fluid pressure to the disc and force the entire disc past the sealing fin and into a position at least adjacent the top panel.

According to a fourth aspect, the present application is directed to a fourth invention comprising an apparatus for positioning a disc in a closure, wherein the closure has a top panel, a skirt depending from the top panel, and an annular sealing fin extending inwardly and downwardly from an interior of the closure and being integrally formed with the top panel, the sealing fin being adapted to engage a rim of a container and be folded into a sealing arrangement with the rim and at least a side of the finish of the container when the closure is secured to the container, the apparatus comprising:

(a) an insertion station for supporting a closure for at least a portion of the disc positioning process; and

(b) a tool movable relative to the insertion station to relatively drive a disc into the closure, the tool comprising a plunger for relatively pressing said disc into said closure such that at least a portion of the disc is adjacent the top panel, and a fluid flow passage through which fluid travels to apply fluid pressure to the disc and force the entire disc past the sealing fin and into a position at least adjacent the top panel.

In a preferred embodiment of the third and fourth aspects, the closure is preferably positioned within the insertion station beneath the tool. In this embodiment, the tool preferably moves relatively downwardly in operation, with the tool forcing the disc into the closure. In this case, it will be understood that the closure is positioned such that the annular skirt extends upwardly from its top panel.

In an embodiment of the third and fourth aspects, the tool can further comprise a cutter for cutting a disc from a sheet or feedstock of disc material positioned adjacent the closure when the closure is in its insertion station. The cutter is preferably able to cut a circular disc from the sheet or feedstock of disc material. The cutter can be annular in form.

The cutter is preferably positioned so as to cut the sheet or feedstock material immediately outwardly of a disc abutment surface of the plunger. In a preferred embodiment, the tool is operable such that the cutter and plunger at least initially move, preferably downwardly, together. As such, the disc is preferably immediately moved downwardly by the plunger on the cutter passing through the sheet or feedstock.

The tool is further adapted such that a stop is provided to prevent further travel of the cutter once it has passed through the sheet or feedstock material. In one embodiment, the cutter preferably moves upwardly at the end of its down stroke ready for the next cycle.

In one embodiment of the third and fourth aspects, the plunger is in the form of a cylindrical tube having an inner and outer surface and the disc abutment surface, the inner surface defining a lumen. In one embodiment, a pin can extend through the lumen of the tube of the plunger and also preferably has an outer cylindrical surface and a disc abutment surface. The pin and the plunger are preferably adapted to move into the closure in concert. Once the disc has been inserted into the closure, the pin and plunger also preferably move together relatively out of the closure. Despite this, it will be appreciated that the pin and plunger could move separately within the tool if required.

In another embodiment, the tool can be provided without a pin in the lumen of the plunger, the lumen providing a fluid flow passage as described below.

Where the pin extends through the lumen, the construction of the tool in the third and fourth aspects is preferably such that the fluid flow passage is provided between the outer surface of the pin and the surface of the lumen of the tubular plunger. In this embodiment, the fluid flow passage is preferably annular in form. Where no pin is present, fluid flow can occur through the lumen of the plunger.

The fluid flow passage preferably comprises a passage for air flow. The apparatus further preferably comprises an air suction device and/or an air blower device. The fluid flow passage is preferably in fluid communication with the air suction device and the air blower device. In one embodiment, the air suction device and air blower devices can be separate items. In another embodiment, the air suction

device and the air blower device can comprise the same device. Where the air suction device and air blower device are different devices, the apparatus can further comprise a valve for switching the passage from being in fluid communication with the suction device to being in fluid communication with the air blower device and vice versa. In one embodiment, a compressor can be used to provide air flow through the tool.

On initial relative movement of the plunger, the fluid flow passage is preferably in fluid communication with the suction device. This serves to hold the disc to the disc abutment surface as the plunger is firstly inserting the disc into the closure so bringing at least a portion, such as a central portion, of the disc into a position at least adjacent the underside of the top panel.

Once in this position, the suction device can be de-activated and the air blower device can be activated to blow air through the fluid flow passage. Alternatively, the valve can be activated and so disconnect the passage from the suction device and bring the passage into fluid engagement with the blower device. This air flow preferably serves to force the disc, and particularly the periphery thereof past the sealing fin and into a position between the top panel and the sealing fin.

The apparatus can be adapted to be manually operated as required. For example, the plunger and cutter, and pin if present, can be mounted to a handle to allow manual control of the operation of these components of the tool. In another embodiment, the apparatus can be adapted to operate semi-automatically or automatically while ever suitable closures are fed to the insertion station. In one embodiment, the apparatus can have a control system that senses when no closure is present in the insertion station and so prevents operation of the apparatus. The control system can also preferably sense when no sheet or feedstock material for the disc is present for feeding into the apparatus and so prevents operation of the apparatus.

In one embodiment of the above aspects, the sealing fin of the closure can comprise an inner or root portion that extends downwardly from an underside of the top panel of the closure. In one embodiment, the inner or root portion can, for at least a portion of its length, be also integral with the skirt of the closure. In another embodiment, the inner or root portion can be positioned radially inwardly from the skirt portion. In this embodiment, the inner or root portion preferably has an inner surface substantially parallel to the skirt of the closure.

Still further, the sealing fin preferably has a second portion that tapers inwardly and downwardly from the inner or root portion and defines an opening smaller than the diameter of the disc. Due to the flexibility of the sealing fin and the fluid pressure exerted on the disc, the disc is able to move past the sealing fin and remain in place between the underside of the top panel and the sealing fin until the closure is applied to the container. On securing of the closure to the container, the second portion is preferably engaged by the rim of the container and folded back towards the inner surface of the inner or root portion to form a seal between with the rim and at least a side of the finish of the container. When the closure is applied to the container, an effective top and side seal is provided between the closure and the finish of the container. The step of securing the closure to the container also preferably serves to trap the disc between the upwardly facing surface of the second portion of the sealing fin and the underside of the top panel. In this arrangement, the disc is preferably out of contact with all portions of the container and does not participate in forming a seal between the closure and the container.

In a still further embodiment of the above aspects, the disc is moulded or fabricated from a polymeric material. In one embodiment, the disc can be a barrier disc with the disc formed from a polymeric material that preferably has gas barrier properties. In one embodiment, the polymeric material can be selected from the group comprising ethylene vinyl alcohol (EVOH) and a liquid crystal polymer polyester material (LCP). In a further embodiment, the polymeric material can include an oxygen-scavenging material embedded therein.

In yet another embodiment, the closure is moulded in a single piece. The closure can be moulded from a polymeric material. The polymeric material can be selected from a group comprising high density polyethylene, low density polyethylene, polypropylene, and co-polymers of polyethylene and polypropylene.

In a still further embodiment, the inner surface of the skirt of the closure can have an inwardly projecting and helically extending continuous or interrupted thread complementary to a thread on the finish of the container.

In yet another embodiment, the lower, free end of the skirt can be provided with a tamper-indicating band for engagement with a bead or other projection on the finish of a container.

Brief Description of the Drawings

By way of example only, a preferred embodiment of the invention is now described with reference to the accompanying drawings, in which:

Figs. 1a-1f depict the steps of one embodiment of the process for inserting a disc or liner in one embodiment of a closure according to the present invention;

Fig. 2 is a plan view of another embodiment of a closure having a liner or disc inserted using the process depicted in Figs. 1a-1f;

Fig. 3 is a sectional view taken along line 3-3 of Fig. 2;

Fig. 4 is a fragmentary view, showing in cross-section, the closure of Figs. 2 and 3 applied to a finish of a container; and

Fig. 5 is a cross-sectional view of a portion of another embodiment of an apparatus according to the present invention.

Preferred Mode of Carrying out the Invention

The steps of a method and portions of a tool for inserting a disc or liner, such as a barrier disc, within a closure are depicted in Figs. 1a-1e. One embodiment of a closure having a disc inserted therein is depicted generally as 40 in the drawings.

Closure 40 has been moulded prior to the liner insertion process depicted in Figs. 1a-1e and delivered to a position adjacent and relatively below the insertion tool 50. While not depicted in Figs. 1a-1e, it will be appreciated that the closure would be supported in an insertion station in the position depicted in these Figures to ensure appropriate alignment of the closure 40 with the tool 50. In this regard, Fig. 5 depicts an alternative apparatus, generally depicted as 70, having an insertion station 71 having

a chamber 73 for receiving a closure. The insertion station 71 could equally be used in conjunction with the insertion tool 51 depicted in Figs. 1a-1e.

As depicted by Fig. 1a, on delivery of the closure 40 to the insertion location below the tool 50, a sheet of disc material 51, in this case barrier disc material, has been loaded so as to be passed through the tool 50. During the process steps depicted by Figs 1a-1e, the sheet 51 is stationary. However, it will be appreciated that when the tool reverts to the position depicted in Fig. 1a, the sheet 51 can be advanced through the tool 50 using a drive so that a fresh disc can be cut therefrom. While not depicted, the film could be advanced by drive wheels or belts as known in the art.

While the tool 50 is depicted as being adapted to cut discs from the sheet 51 of barrier material as part of the insertion process, it will be appreciated that the tool 50 could be modified such that pre-cut discs were delivered to the tool 50 ready for insertion using the process steps as described herein.

The depicted tool 50 has a disc cutter 52 for cutting a disc from the sheet 51 of disc material during the insertion process. The cutter 52 is shaped to cut a circular disc 20 from the sheet 51 having a diameter suitable to allow the disc 20 to be positioned within the closure 40 as is described in more detail below.

The cutter 52 is positioned so as to cut the sheet 51 immediately radially outwardly of a lower disc abutment surface 54 of a plunger 55. As depicted in Fig. 1b, the tool 50 is operable such that the cutter 52 and plunger 55 at least initially move downwardly together. As such, the disc 20 is immediately moved downwardly by the plunger 55 on the cutter 52 passing through the barrier sheet 51. When the cutter 52 and plunger 55 reach the position depicted in Fig. 1b, a stop (not visible) prevents further downward travel of the cutter 52. While the cutter remains depicted at the lower end of its range of travel in Figs. 1b-1e, it will be appreciated that the cutter 52 will eventually revert to its start position depicted in Fig. 1a. This could happen prior to the return of the plunger 55 to its start position or concurrently therewith.

The plunger 55 is in the form of a cylindrical tube having an inner surface 56 and an outer surface 57. In Figs. 1a-1e, the tool 50 further comprises a central pin 58 that extends through the lumen of the tube of the plunger 55 and also has an outer cylindrical surface 59 and a lower disc abutment surface 61. The pin 58 and the

plunger 55, as depicted in Figs. 1b-1e, are adapted to move downwardly into the closure 40 in concert. Once the disc 20 has been inserted into the closure, the pin 58 and plunger 55 also move relatively upwardly out of the closure 40. Despite this, it will be appreciated that the pin 58 and plunger 55 could move separately within the tool 50 if required.

As depicted in Figs. 1c and 1d, the plunger 52 firstly presses the disc 20 into the closure 40 such that at least a central portion of the disc 20 is adjacent the underside of the top panel of the closure 40.

To prevent the disc 20 falling off the end of the plunger 55 during the insertion steps depicted in Figs. 1c and 1d, suction is provided to form a region of relatively low pressure at the disc abutment surface 54 that is sufficient to hold the disc 20 thereto.

To provide the suction, the tool 50 has an annular air flow passage passing at least partially therethrough between the outer surface 59 of the pin 58 and the surface 56 of the lumen of the tubular plunger 55. As depicted in the drawings, the air flow passage is provided by providing the pin 58 within an outer diameter that is just relatively smaller than the diameter of the plunger 55. It has been determined by the present inventors that a relatively small passage width is sufficient to provide the necessary degree of suction to the disc 20 as it is inserted into the closure during the steps depicted in Figs. 1c and 1d. This small passage width can be provided by simply ensuring that the pin 58 is able to slide relatively freely within the lumen of the plunger 55.

Before completing the description of tool 50, it is appropriate to review an alternative construction for the plunger depicted in Fig. 5. In this case, the tool 70 also has a cutter 72 and a plunger 75. In this embodiment, no pin is provided in the lumen 76 of the plunger and instead, the lumen 76 itself acts as a fluid flow passage through the tool. Here, the sheet or feedstock 51 of disc material is fed through a slot 74 in the receiving station 71 and is thus appropriately positioned relative to the closure when the closure is present in the chamber 73.

Returning to the embodiment depicted in Fig. 1d, because of the presence of the sealing fin 22 and the diameter of the disc 20, the periphery 20a of the disc 20 is unable to be fully pressed into the closure 40 by plunger 55. To force the periphery 20a of the

disc 20 past the sealing fin 22, the air flow through the passage is changed when the plunger 55 has reached the position depicted in Fig. 1d. In this regard, the direction of air flow is changed from travelling in direction A depicted in Fig. 1c to direction B depicted in Fig. 1e. The application of air pressure to the disc 20 results in the periphery 20a of the disc moving past the sealing fin 22 with the result that the entire disc 20 is held in the closure 40 between the sealing fin 22 and the underside of the top panel.

While not depicted, it will be appreciated that an air suction/air blower device could be used in fluid communication with the passage to provide the airflow as described above. A compressor could also be utilised in combination with the apparatus.

Either after, during or just prior to the provision of air flow to force at least the periphery 20a of the disc 20 past the sealing fin 22 into the closure 40, the plunger 55 and the pin 58 can be withdrawn relatively upwardly.

Another depiction of a closure that can have a liner or disc inserted using the apparatus and method defined herein is provided by Figs. 2-4. These drawings serve to highlight the features of the closure formed using the apparatus and method of the present invention.

The closure assembly 40 is made up of a generally cup-shaped closure element 12, which is made up of an imperforate top panel 14 with an annular skirt 16 depending downwardly from an edge of the top panel 14. The closure assembly 40 also includes, as a separate element, a disc-shaped liner 20 that underlies the underside or inwardly facing side of the top panel 14. In this case, the liner 20 of closure 40 is placed in the closure using the method and apparatus described in association with Figs. 1a-1e.

The closure element 12, which also has an inwardly projecting helical thread 18 for application to a glass or plastic bottle with an externally projecting helical thread on its neck or finish, is produced by injection or compression moulding from a suitable thermoplastic material, for example, high density polyethylene, polypropylene, low density polyethylene, or copolymers of polyethylene and polypropylene. Unfortunately, such materials have relatively low resistance to the permeation of gases therethrough, either oxygen from the atmosphere into the package or CO_2 or N_2 from

the interior of the package to which the closure assembly is applied to its exterior. This problem is overcome by inserting a disc-shaped barrier liner 20 having barrier properties into the closure element 12.

The depicted liner 20 is molded or fabricated from a material that has excellent resistance to the passage of gases therethrough, for example, EVOH (ethylene vinyl alcohol) or LCP (liquid crystal polymer), and these materials are especially resistant to the migration of oxygen therethrough. Resistance to the migration of oxygen into a container filled with an oxygen-sensitive product, such as beer or anther malt beverage product, is especially important because of the propensity of oxygen to degrade the flavor of such a packaged product, and this factor may be enhanced by embedding oxygen-scavenging materials into the material from which the liner 20 is molded or fabricated. In any case, such liner materials, with or without an oxygen scavenger, also inhibit the outflow of CO_2 from a container filled with carbonated soft drinks, and the outflow of N_2 from plastic containers filled with still drinks, such as sports drinks, which are often pressurized with N_2 to rigidify an otherwise flexible container during shipment and handling. Further, a thin layer of a moisture barrier material, may, desirably, be provided over an inwardly-facing surface of the liner 20 when it is formed of a moisture-sensitive material, such as EVOH, and such covering layer may also have an oxygen-scavenging material embedded therein.

In the case of a closure assembly 40 intended for the packaging of a pressurized beverage, it is contemplated that the helical thread 18, which is shown as being continuous between its ends, may also be interrupted at various locations along its length, for example, in accordance with the teachings of US Patent 5782369 (Tansey), the disclosure of which is also incorporated by reference herein. In this case, it may also be preferred to provide a complementary formed helical rib on a container with an interrupted thread.

The closure element 12 has an integrally-molded sealing rib 22 that is molded concentrically with the annular skirt 16. The sealing rib 22 has an inner or root portion 24 that extends downwardly from the underside of the top panel 14 of the closure element 12 approximately parallel to the annular skirt 16, and a second portion 26 that extends downwardly from a distal end of the inner portion 24. The second portion 26 tapers inwardly and downwardly from the inner portion 24 and has a distal end that defines an opening that is smaller than the diameter of the liner 20. Thus, due to the

flexibility of the sealing rib 22, it is possible to insert the liner 20 into the closure element 12 to the position depicted in Fig. 3, and the liner 20 will then remain in place until the closure assembly 40 is applied to a finish of a container 30, a fragment of which is depicted in Fig. 4.

In the application of the closure assembly 40 to the finish of the container 30, a rim or an annular surface 32 of the container 30 engages a free or distal end of the second portion 26 of the sealing rib 22 and forces it back towards the inner portion 24 of the sealing rib 22. Thus, an outer portion of the second portion 26 of the sealing rib 22 will form a pressure seal against the rim 32 of the container 30, and an inner portion of the second portion 26 of the sealing rib 22 will form a pressure seal against a terminal side portion 34 of the finish of the container 30. As a result, when the closure assembly 40 is applied to a container 30, there will be an effective top and side seal between the liner 20 of the closure assembly 40 and the container 30, and such a top and side seal is considered to be required for proper sealing of a pressurized container. The step of applying the closure assembly 40 to the container 30 will also trap the liner 20 between an upwardly facing surface of the outer portion 26 of the sealing rib 22 and an inwardly facing surface of the top panel 14 of the closure element 12. In this position, the liner 20 will be out of contact with all portions of the container 30, and will not participate in forming a seal between the closure assembly 40 and the container 30.

While not specifically shown in Figs. 2-4, the lower, free end of the skirt 16 of the closure element 12 in this embodiment may also be provided with a tamper-indicating band for engagement with a bead or other projection on the finish of a container, as taught, for example, by the aforesaid US Patent Nos 5782369 and 4721221. Figure 1f does depict closure 40 having one type of tamper-evident band 41 that can be moulded with the closure.

The present invention provides an apparatus and method for inserting a liner within a moulded closure.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.